



COMPARATIVE ANALYSIS OF BIODIESEL PROPERTIES DERIVED FROM WASTE MUSTARD OIL AND FRESH MUSTARD OIL

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ABSTRACT

This study investigates the production of biodiesel from waste mustard cooking oil and fresh mustard oil, focusing on their comparative properties. Biodiesel, a renewable energy source, offers a sustainable alternative to fossil fuels, mitigating environmental concerns and enhancing energy security. The production process involves transesterification, converting triglycerides into fatty acid methyl esters (FAMES), the primary constituents of biodiesel. Waste cooking oil, often discarded improperly, poses environmental challenges due to its disposal. Utilizing it for biodiesel production presents an eco-friendly solution while addressing waste management issues. Mustard oil, a common edible oil, serves as a viable feedstock for biodiesel production, offering potential economic benefits and reducing dependency on fossil fuels.

KEYWORDS: Waste Mustard Cooking Oil, Fresh Mustard Oil, Biodiesel, Transesterification, Triglycerides, Fatty Acid Methyl Esters

INTRODUCTION

The quest for sustainable and renewable energy sources has intensified over recent decades due to the depleting reserves of fossil fuels and the increasing environmental concerns associated with their use. Biodiesel, derived from vegetable oils and animal fats, emerges as a promising alternative, offering a renewable and environmentally friendly fuel option. Mustard oil, in particular, has garnered attention due to its high oil content and favourable fatty acid composition. Fresh mustard oil has been widely studied and utilized in biodiesel production, demonstrating properties that align with biodiesel standards such as ASTM D6751 and EN 14214. However, the potential of waste mustard oil, often disposed of improperly and causing environmental hazards, remains underexplored. Transforming waste mustard oil into biodiesel not only addresses waste management issues but also contributes to the sustainable production of renewable energy.

Previous research has established that the properties of biodiesel can vary significantly depending on the feedstock used. For instance, studies by Moser (2010) and Demirbas (2009) have shown that biodiesel derived from waste cooking oils can exhibit different physical and chemical characteristics compared to those from fresh oils, impacting its performance and emission profiles. Additionally, Sharma et al. (2020) highlighted the variability in biodiesel properties based on feedstock quality and processing conditions. This paper aims to provide a comprehensive comparison between biodiesel produced from waste mustard oil and fresh mustard oil, evaluating critical parameters such as density, viscosity, calorific value, and emission characteristics. By doing so, this research seeks to determine the viability of waste mustard oil as an alternative feedstock for biodiesel production, contributing

to a more sustainable and cost-effective approach to renewable energy.

ORIGIN OF MUSTARD

International

In the current global agricultural landscape, mustard is extensively cultivated, with Canada, India, and China being major producers. Canada leads in yellow mustard production, while India focuses on brown and black varieties. Mustard seeds are widely used in food products like condiments and traditional cuisines, and mustard oil is valued for its health benefits and culinary uses, especially in South Asia. The increasing interest in mustard oil for biodiesel production highlights its environmental advantages. Mustard cultivation also benefits soil health and pest resilience, making it a key crop for sustainable agriculture. As demand for versatile and sustainable crops grows, mustard's role in food security, health, and renewable energy remains significant.



Figure 1: Mustard Flower

India

In India, mustard is a crucial oilseed crop primarily grown in states like Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, and Gujarat, with Rajasthan leading in production. It is cultivated during the Rabi season (October to March) and supports millions of small farmers. Government initiatives, such as minimum support prices and subsidies, bolster mustard farming. Mustard oil, favored for cooking in northern and eastern India, is valued for its health benefits. The seeds are also essential in traditional cuisine. Additionally, mustard's potential as a biofuel feedstock is being explored, contributing to India's sustainable energy efforts.

MATERIALS & METHODS

For this study, fresh mustard oil was sourced from a local market, and waste mustard oil was collected from restaurant waste. Both oils were converted to biodiesel via transesterification using methanol and sodium hydroxide as a catalyst. The biodiesel properties were assessed using standard testing methods: density was measured with a pycnometer, viscosity with a viscometer, and calorific value with a bomb calorimeter. These tests were conducted to compare the properties of biodiesel derived from waste and fresh mustard oil and to determine the viability and environmental impact of using waste mustard oil as a biodiesel feedstock.



Figure 2: Setting up of experimental setup

RESULT AND DISCUSSION

Property	Fresh Oil Biodiesel	Waste Oil Biodiesel	Testing Method
Density (Kg/m ³)	0.830	0.834	IS:1448-1977(P-20)
Ash content (%)	0.01	0.015	IS:1448(P-4)
Flash Point (°C)	59	54	IS:1448(P-20)
Kinematic Viscosity (cSt)	2.9	3.1	IS:1448(P-7)
Calorific Value (KJ/Kg)	42210	41794	IS:1448(P-7)
Acid Value (Mg KOH/g Biodiesel)	0.317	0.689	IS:548(Part 1)
Free Fatty Acid	0.158	0.345	IS:548(Part 1)

CONCLUSION

The comparison of properties between fresh cooking oil and waste cooking oil highlights the multifaceted considerations involved in selecting the most suitable oil for various applications. While fresh oil boasts higher purity and energy content, waste oil presents environmental advantages and cost-effectiveness, especially in biodiesel production. Ultimately, the choice between fresh and waste cooking oil depends on factors such as purity requirements, sustainability goals, and economic considerations, emphasizing the importance of informed decision-making tailored to specific needs and objectives.

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